

**EQUIPMENT AUTHORIZATION FOR
CERTAIN DEVICES TO OPERATE ON
SPECTRUM AUCTIONED BY THE
COMMISSION**

James Warden

Director, Advanced Research

Research In Motion



Current Smart Phone Landscape

- Meeting technical specs isn't our only challenge.
- The device has to provide an attractive appearance, a smart user interface, great applications, a reliable connection over many RF interfaces and technologies.



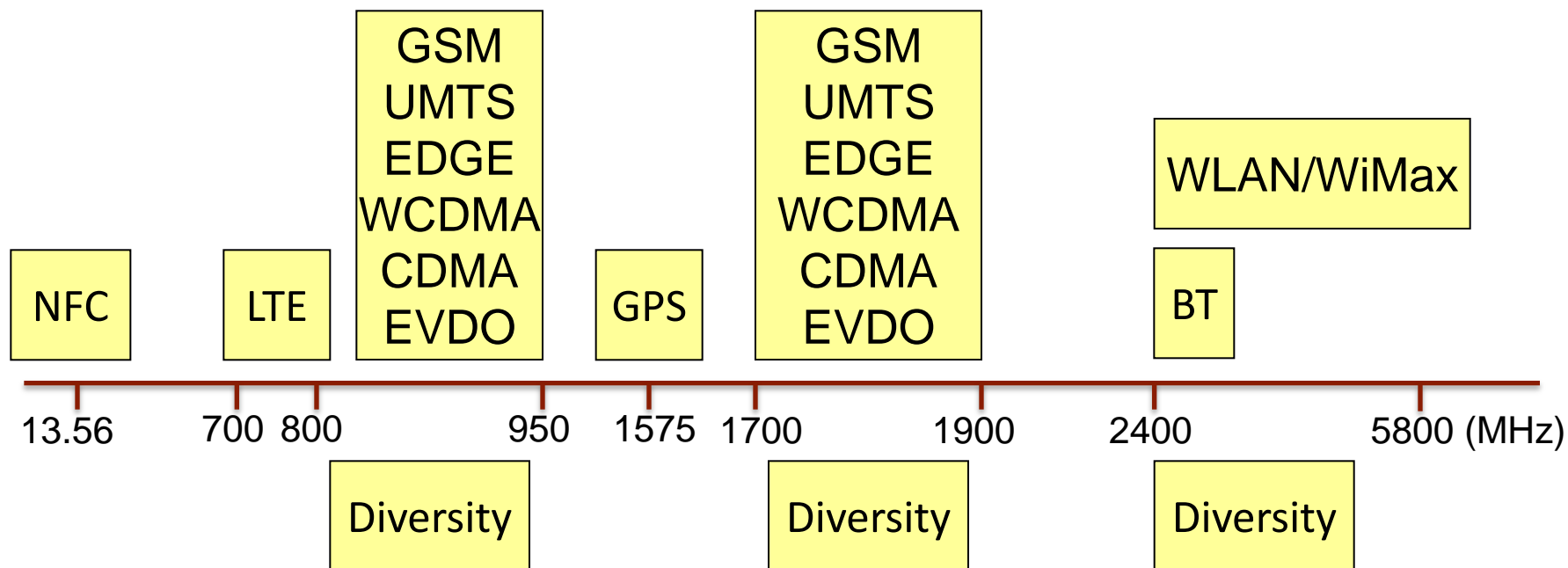
Challenges Facing Handset Manufacturers

- Aggressive ID (Industrial Design)
- Mechanical and structural limitations (dimensions, curvature, metal frame, etc)
- Tighter customer/carrier requirements
- EMC/EMI issues

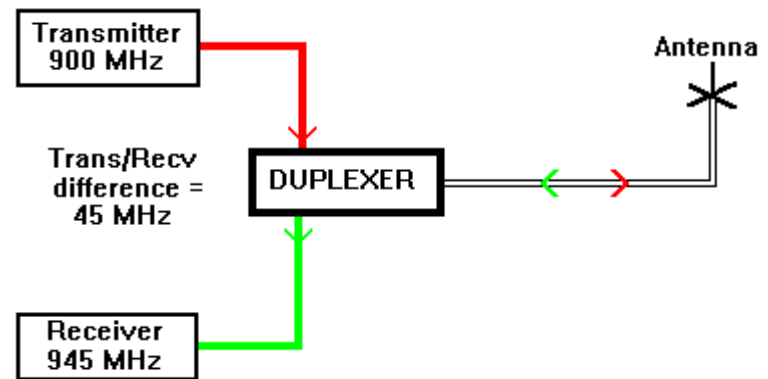
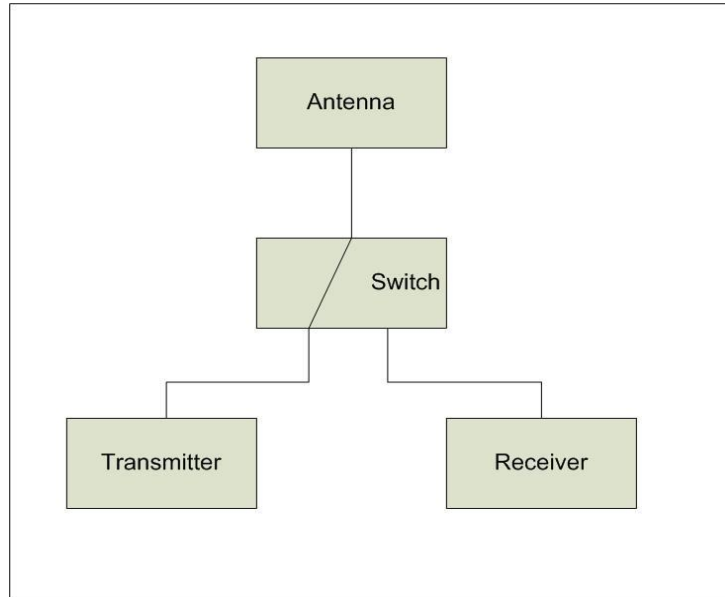


Technologies and Bands

- Mobile phones are required to support a wide range of wireless technologies
- In most devices, two antennas are a minimum and five or more antennas are generally needed in a smart phone.

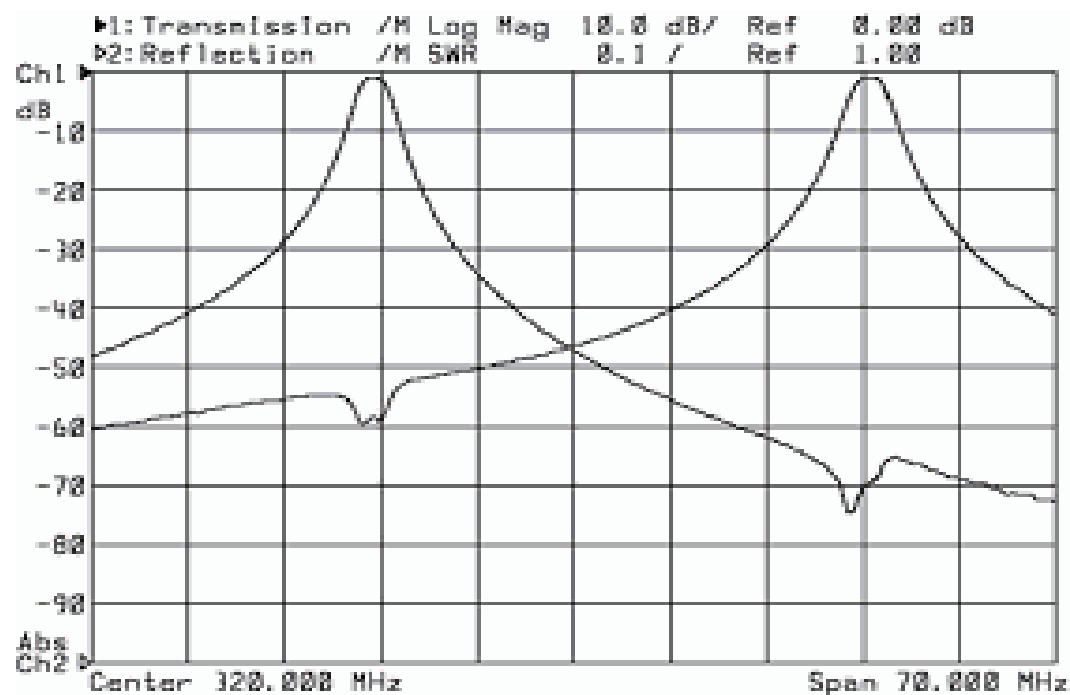


Simplex vs. Full Duplex



SIMULTANEOUS SIGNAL FLOW THROUGH A DUPLEXER

Duplexer Response



LTE Bands

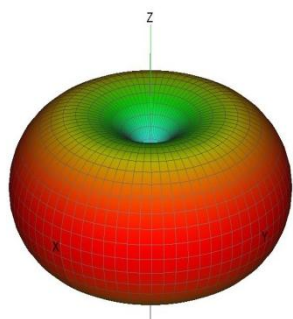
LTE Band Number	Uplink (MHz)	Downlink (MHz)	Main Regions of Use
1	1920 - 1980	2110 - 2170	Asia, Europe
2	1850 - 1910	1930 - 1990	Americas, Asia
3	1710 - 1785	1805 -1880	Americas, Asia, Europe
4	1710 - 1755	2110 - 2155	Americas
5	824 - 849	869 - 894	Americas
6	830 - 840	875 - 885	Japan
7	2500 - 2570	2620 - 2690	Asia, Europe
8	880 - 915	925 - 960	Asia, Europe
9	1749.9 - 1784.9	1844.9 - 1879.9	Japan
10	1710 - 1770	2110 - 2170	Americas
11	1427.9 - 1452.9	1475.9 - 1500.9	Japan
12	698 - 716	728 - 746	USA
13	777 - 787	746 - 756	USA
14	788 - 798	758 - 768	USA
17	704 - 716	734 - 746	USA
18	815 - 830	860 - 875	Japan
19	830 - 845	875 - 890	Japan
20	832 - 862	791 - 821	Europe
21	1447.9 - 1462.9	1495.5 - 1510.9	Japan
22	3410 - 3500	3510 - 3600	

USA LTE Bands

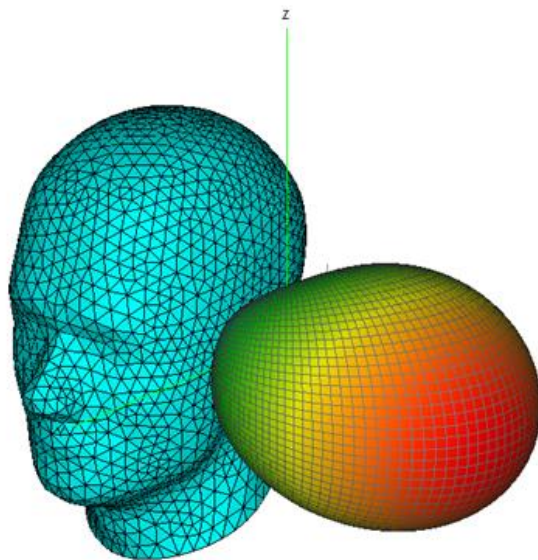
12	698 - 716	728 - 746	USA
13	777 - 787	746 - 756	USA
14	788 - 798	758 - 768	USA
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Specific Absorption Rate (SAR)

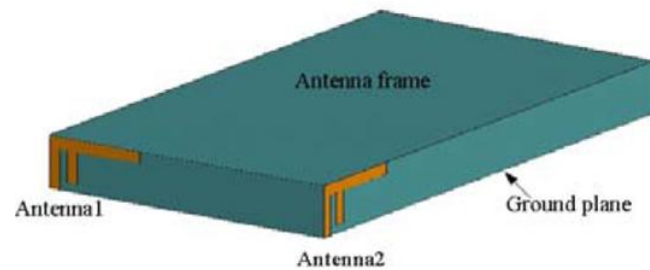
- SAR is an FCC spec that phones must comply to
- A Low SAR value can be obtained by proper design of the device and proper antenna placement.
- How a user holds the phone will impact the antenna radiation pattern and the SAR value.



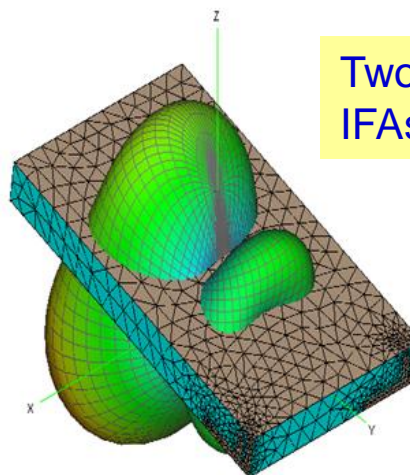
Monopole pattern



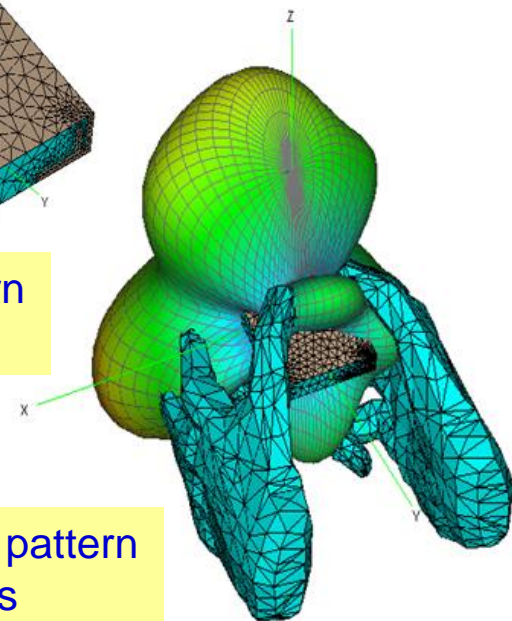
Monopole antenna pattern with human head



Two orthogonal IFAs in the handset

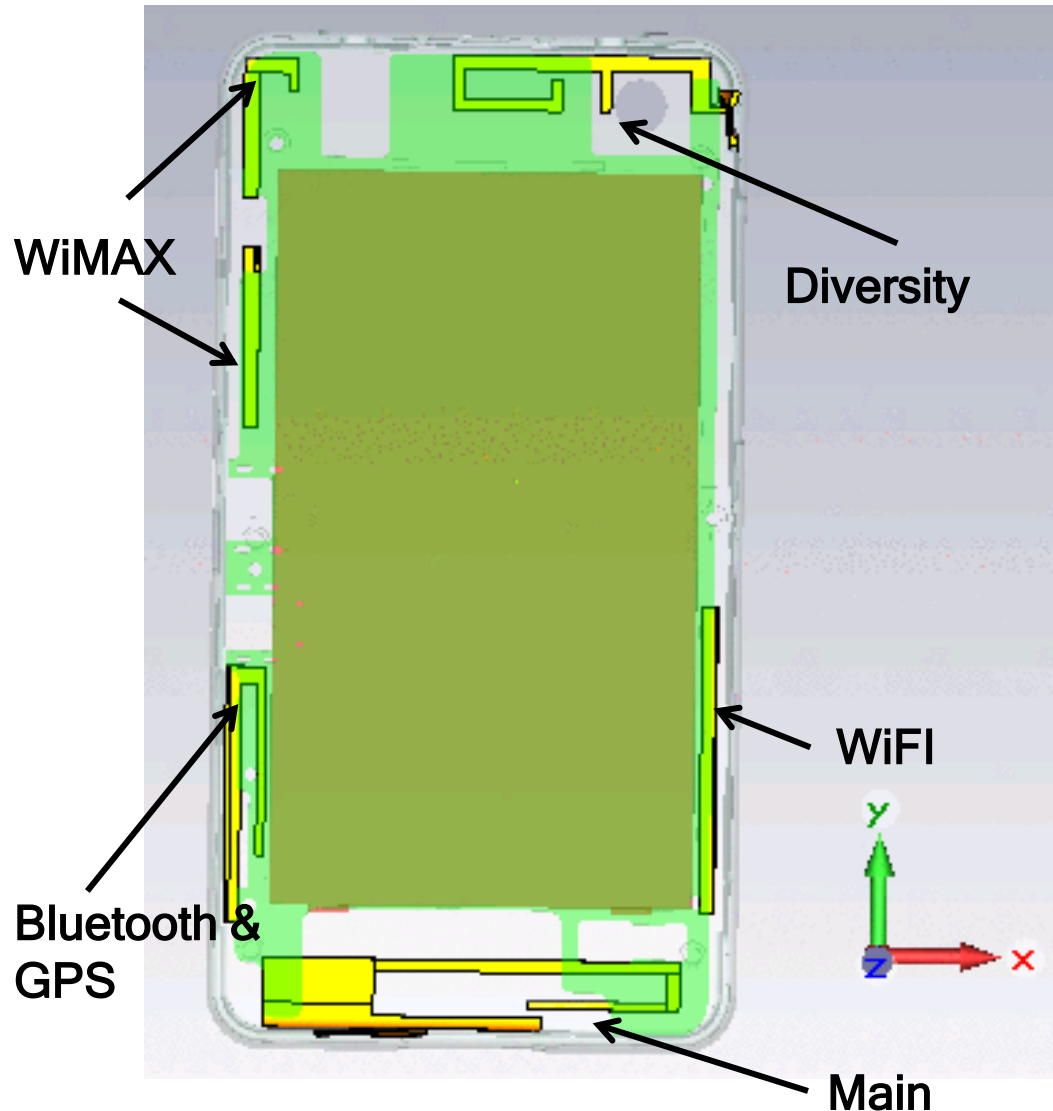


Radiation pattern of two IFAs



Radiation pattern with hands

Antenna Placement in the Handset



Challenges

- Components (such as shield cans, speaker, camera) are directly behind the antenna.
- Larger batteries limit the space allocated for the antennas.
- Distance between PCB/bracket and antenna should be $>3\text{mm}$ (BT, GPS, WiFi and WiMax); for low bands it should be even higher.
- Space under antenna element should be clear of any shields, flexes, or components
- Modern small phone should include NFC solution of 0.3mm .

Size Constraints

- Antenna size increases as frequency decreases
- Duplexer size typically increases as frequency decreases
- Bandwidth requirements for LTE (4G) are greater (20 MHz)



Could slow LTE adoption

- If all 700 MHz band blocks have to be supported by a device
 - Size constraints would likely force this band out of products or the device might be 700 MHz only
 - Other Bands with the majority of current users would take priority



BlackBerry

Conclusions

- **What was intended to promote interoperability would likely have the opposite effect**
- **Size constraints are such that there are one of two outcomes**
 - **700 MHz band adoption is slowed**
 - **Devices would be less interoperable overall because at least some of the bands, where the majority of users currently operate, would have to be left out of devices**